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PROGRAM AND ABSTRACTS

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only different requirements for cleanliness but also various technologies and methods proposed. In this presentation water-based cleaning agents and hydrocarbon-based solvents are compared, clearly demonstrating advantages for the aqueous system. This is especially true for those coating systems where an effective plasma etching prior to deposition is missing. As a conclusion from these results an overall concept for a new demonstration plant has been developed and realised. It is now possible to prepare any kind of material (steel, aluminium, copper, glass, ceramic etc.) contaminated with organic and/or inorganic compounds due to the combination of single cleaning steps. Thereby the cleaning procedure must be adapted to material, contamination and consecutive manufacturing. Available sections include degreasing, activation, passivation (to prevent corrosion), multistage rinsing and finally drying by an innovative system combining hot-air and vacuum. Examples will demonstrate the effectiveness of this concept which is highly reduced in the use of cleaning agents and water resulting from intelligent process cycles and other means assisting the cleaning process. Furthermore an extended lifetime and high quality of functional cleaning bathes can only be assured by quality control measuring specific properties like conductivity or surface tension.

GP-11 Large Area High Density Plasma Source by Helical Resonator Arrays, *S.-G. Park, B-H. O, S.H. Lee*, Inha University, South Korea

An array of smaller unit plasma sources have been be used for generating larger area plasma to process large substrates such as flat panel display (FPD). In this work, four helical resonators are distributed in a 2x2 array by modifying upper part of the conventional reactive ion etching (RIE) type LCD etcher. Since the resonance condition of the individual unit can be easily found by adjusting the tapping position of RF signal to the helical antenna, one RF power supply is used for delivering the power efficiently to all four helical resonators without an impedance matching network. Previous work of 2x2 array inductively coupled plasma (ICP) requires one matching circuit to each ICP antenna for more efficient power delivery. [1] Distributions of ion density and electron temperature are measured in terms of chamber pressure, gas flow rate and RF power. By adjusting the power distribution among the four helical resonator units, argon plasma density of higher than $10^{16}/m^3$ with the uniformity of better than 7% can be obtained in the $620x620mm^2$ chamber.

[1] C. Chan, U.S. Patent No. 5,653,811 (1997).

GP-12 The Use of Magnetron Arrays for the Deposition of Large-area Oxide Coatings, *A.F. Jankowski, M.A. McKernan*, Lawrence Livermore National Laboratory

The sputter deposition of coatings over large areas is often approached through the use of large, rectangular planar magnetrons. A wide range of applications for large area coatings includes the deposition of dielectric layers on silicon, anti-reflective coatings on glass, corrosion resistant coatings on metals, and more recently, multilayers for x-ray optics. An alternative to the rectangular magnetron can be beneficial to minimize the expense of target materials and the cost of large deposition source(s). One feasible approach is to use an array of circular planar magnetrons. In a prior demonstration, the use of two linear arrays of three, one-inch diameter magnetron sources as operated in the dc mode provided an effective means to deposit uniformly spaced multilayers across a 15 cm wide path. A greater number of synchronously operated, larger diameter sources is required for wider coating paths. Presently, we investigate the use of a linear array of three-inch diameter magnetron sources operated in the rf mode to deposit an oxide target material across a path in excess of 70 cm. Results are given for the performance of the planar magnetrons in depositing a 1 μm thick alumina coating.

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GP-13 Dry Etch Characteristics of Al-Nd Films for Thin-film-transistor Liquid Crystal Displays, *H.R. Han, Y.J. Lee*, Sungkyunkwan University, Korea, *K.H. Oho*, National Institute of Technology and Quality, Korea, *M.P. Hong*, Samsung Semiconductor, Korea, *G.Y. Yeom*, Sungkyunkwan University, Korea

Al-Nd films are generally used for TFT-LCD gate electrode application due to the high heat tolerance on hillock formation during the post-annealing processes. Currently, the patterning of Al-Nd films is done by wet etching and, due to the material and chemical selectivity of the wet etching, problems such as Nd residues and irregular electrode line shapes are remained. Therefore, dry etching techniques are actively investigated to replace for gate electrode etching of the next generation TFT-LCD. In this study, Al-Nd thin films deposited on glass were etched using magnetized inductively couped plasmas (MICP) and the etch characteristics were investigated as a function of gas conbination, pressure, dc self-bias voltage, and inductive power. Gas combination of Cl_2, BCl_3, and HBr were used with pressures in the range of 5mTorr to 30mTorr, dc self-bias voltages from -50V to -200V, and inductive powers from 400W to 800W. Using Cl_2/BCl_3 gas mixtures, the etch rates of Al-Nd films less than 1000Å/min and etch selectivities over photoresist less than 0.5 were obtained due to the non-volatile Nd in the Al-Nd thin films. Also, some defects were observed on the surface of glass after the etching of Al-Nd originated from the remaining Nd. On the other hand, the use of BCl_3/HBr chemistry increased Al-Nd etch rate close to 1500Å/min and etch selectivity close to 1. In addition, barely no surface defects could be found with this chemistry. Using the plasma diagnostic tools such as optical emission spectrscopy (OES) and quadruple mass spectroscopy (QMS), the etching mechanisms with these chemistries were investigated. Variations of surface composition of the Al-Nd samples during the etching and after the etching for various gas mixtures were also investigated using X-ray photoelectron spectroscopy (XPS). The etch profiles and surface defects were observed with a scanning electron microscope (SEM). [1]nter each footnote and reference separated by a blank line.

GP-14 Characteristics of Magnetized Inductively Coupled Plasma Source for Large Area Flat Panel Display Applications, *Y.J. Lee, H.R. Han, G.Y. Yeom*, Sungkyunkwan University, Korea

In order to achieve the performance required for higher resolution flat panel display(FPD) devices of next generation, improved dry etch processes currently indispensable technology for semiconductor industry are required for volume manufacturing and superior critical dimension control. Most of the dry etching equipments currently available for FPD devices are based on the capacitive plasma excitation. These types of etch equipments, however, are suffered from relatively low plasma densities, therefore low etch rates. To increase the etch rates, one of the high density plasma sources, inductively coupled plasmas (ICP) source is generally studied for the application, but plasma nonuniformity which is key technical requirement for FPD process is still remained as a problem. In this study, to improve both the plasma density and the uniformity of ICP source, permanent magnets and Helmholtz type axial electromagnets were used to the conventional ICP source and the effects of various magnet combinations and process conditions on the polysilicon etch rates and etch uniformities were studied. The permanent magnets having 3000G on the magnet surface were arranged along the chamber wall by varying center-to-center distance of the magnets, and also 20Gauss of the Helmholtz type axial electromagnet was added to the permanent magnet to improve plasma density. There was a strong relationship between the combination of the magnets and plasma characteristics such as density and uniformity. Under optimized combinations of both the permanent magnets and the axial electromagnets around the chamber wall, the plasma uniformity better than 4% could be obtained while maintaining high plasma ion densities higher than $3 \times 10^{11}cm^3$. In the application to poly-silicon etching processes, poly-silicon etch rates about three times higher than those etched using the conventional (non-magnetized) ICP plasmas could be obtained in our experimental conditions. To understand the effects of various magnets and process conditions on the plasma characteristics, a quadrupole masss spectrometer (QMS: Hidern Analytical Inc., PSM 500) and a Langmuir probe (Hiden Analytical Inc., ESP) located on the sidewall chamber were used. [1]nter each footnote and reference separated by a blank line.

GP-15 Direct Temperature Monitoring for Plasma Implantation of Semiconductors, *X.B. Tian, B.Y. Tang, Z.M. Zeng, X.C. Zeng, P.K. Chu*, City University of Hong Kong

Accurate and reliable in-situ temperature monitoring in SPIMOX (Separation by Plasma Implantation of Oxygen) and hydrogen PIII (Plasma Immersion Ion Implantation) - ion-cut is crucial to the success and yield of the two SOI (silicon-on-insulator) fabrication processes. In the former process, the silicon wafer temperature must be kept at above 600°C and in the PIII - ion-cut process, the wafer temperature must be kept below 300°C throughout the experiment. Remote temperature sensing techniques using pyrometers have several drawbacks even though pyrometers are safer to use as they are usually positioned outside of the vacuum chamber. In this paper, we present our direct temperature measurement approach using a thermocouple directly connected to the sample stage. Our special design eliminates many arcing-related problems and enables the device to function properly at implantation voltages over 50 kV. We will present our measurement system and experimental data.

GP-16 Dry Cutting Field Test with DLC Based Multilayer-coated Inserts for Turning, *J.L. Liebich, D.R. Roth, J.S. Schwarte, B.R. Rau, K.-HD. Dittrich*

This paper summarizes results of a field test by cutting force investigations with carbon-coated inserts without any lubrication.